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RADIO-TELEGRAPHY.—*A ship's antenna as a Hertzian oscillator.* L. W. AUSTIN, Naval Wireless Telegraphic Laboratory.

In the work on long distance radio-telegraphy[1] it was shown that the equation giving the value of the current in the receiving antenna in terms of the sending antenna current, the antenna heights, the wave length, and the distance was identical in form with the Hertzian equation for the amplitude of the electric waves at a distance from the oscillator, provided this distance was not great enough to involve the atmospheric absorption.

I have made a calculation of the current which might be expected in a receiving antenna, making use of the form of radiation formula given by Zenneck.[2]

$$E = 2\pi \frac{l}{\lambda} \frac{J}{d} 3 \cdot 10^{10} \text{ c.g.s.}$$

Here l represents the length of the oscillator, λ the wave length, J the current and d the distance in the equatorial plane from the oscillator. The difficulty in applying the equation to the case of the scout cruisers *Birmingham* and *Salem* lies in the determination of the dimensions of the electrical oscillator which would be equivalent to the antenna system of the ships. Considering the antenna as forming half the oscillator, the lower half of which may be imagined to be below the surface of the sea, l would be equal to $2h$ where h is the height to the center of capacity of the antenna. But, since the lower half of the antenna contributes

[1] Bull. Bur. Standards, 7: 315. 1911.
[2] Zenneck, Leitfaden der Drahtlosen Telegraphie, p. 43.

nothing to the radiation, the Hertzian oscillator which will radiate the same amount of energy as the antenna will be[3] $\sqrt{2}\cdot h$. In our case, however, this does not fully determine the value of l, since the wireless room is some 30 feet above the water and enclosed in the steel hull which is at approximately zero potential. Then too, the exact height of the center of capacity of the antenna system is a matter of some uncertainty. Since the lines of electric force to a large extent come down to the water and not to the hull, it is probable that the point where the antenna leaves the hull at the wireless room is somewhat too high to be taken as the center of the oscillator. On the other hand, the center of capacity of the antenna is certainly lower than the level of the flat top antenna. As a probable approximation I have taken the height from the wireless room to the antenna top, 29.2 meters as the value of h. Then $l = 41.3\ m$, $\lambda = 1000\ m$, the average sending current of the two ships, $J = 30$ amperes. Then in c.g.s. units,

$$E = 6.28\frac{4\cdot 13\cdot 10^3}{1.10^5}\frac{3}{1.10^5}\,3\cdot 10^{10} = 2.34\cdot 10^5 \text{ c.g.s.} = 2.34\cdot 10^{-3} \text{ volts per centimeter}$$

The receiving electromotive force on the antenna will be $E\cdot h = 2.34\cdot 10^{-3} \times 2.92\cdot 10^3 = 6.83$ volts. The resistance of the receiving antenna was approximately 25 ohms, thus,

$$\text{Calculated Received Current} = \frac{6.83}{25} = 0.27 \text{ amperes}$$

The corresponding observed value, that is the average of the two values of K in Tables X and XI of the paper already cited, gives

$$\text{Observed Received Current} = 0.21 \text{ amperes.}$$

Considering the difficulties in determining the values of h and the fact that a certain portion of the radiated energy must have and the fact that a certain portion of the radiated energy must have been absorbed by the rigging of the ships, the agreement between the calculated and observed currents seems quite as good as it is possible to expect.

[3] R. Ruedenberg Ann. d. Phys. 25: 446. 1908.

ELECTRICITY.—*The capacity and phase difference of paraffined paper condensers as functions of the temperature and frequency.* FREDERICK W. GROVER. Communicated by E. B. Rosa. To appear in the Bulletim of the Bureau of Standards, **7**: No. 4. 1911.

In an ideal condenser the capacity would be independent of changes in the temperature and the frequency of the measuring current, and the phase of the current thru the condenser would always be 90° ahead of that of the electromotive force impressed on the condenser. In actual condensers these conditions are not exactly fulfilled; the capacity decreases somewhat with increasing frequency and the temperature coefficient of the capacity is appreciable. Further, the phase of the current lags behind the ideal position of 90° in advance of the electromotive force, by an angle θ, which is usually small but always measurable. (In what follows the angle θ will be designated as the *phase difference.*)

To account for these departures from the behavior of an ideal condenser, all of which have their origin in the phenomenon of electric absorption, a number of theories have been proposed which give at least a *qualitative* explanation of the facts. Much of the existing experimental data, has, however, been obtained from experiments with a steady applied voltage, and with such various times of charge and discharge, lengths of insulation or short circuit, and such different galvanometer periods, as to render it very difficult, if not impossible, to decide whether or not there is *quantitative* agreement between any given theory and the observations. To meet this difficulty, measurements with alternating currents would appear to be especially suitable to give data for such comparisons, since the condenser is submitted to a perfectly definite cycle of charging and discharging.

The present paper gives the results of measurements of the capacity and phase difference of thirteen commercial condensers by English, French, German and American firms at temperature ranging from 10° to 35° in steps of 5°, and at frequencies of from 33 to 1000 cycles per second. In every condenser, the dielectric

was of paraffined paper, except in two cases; where paper impregnated in beeswax was employed. Such condensers were selected, on account of their relatively large and varied absorption effects, as being better fitted for a theoretical study of absorption than mica condensers.

The measurements were made by means of alternating current bridge methods in use at the Bureau of Standards,[1] using as indicating instruments vibration galvanometers, tuned to the frequencies of the currents used. This procedure has the advantage, that the balance of the bridge depends on the fundamental component only of the electromotive force wave employed, thus rendering valid in the theoretical work, the assumption of a sinusoidal electromotive force. The condensers were compared, by substitution, with standard mica condensers whose constants were known from previous work, and capacity effects between the different parts of the bridge and the earth were shown to have no influence on the results thus obtained.

The following points of practical importance were established by the measurements:

1. The temperature coefficients of the capacity of those condensers with the smaller values of the phase difference (5′ to 20′), were found to be negative and nearly constant, 2 to 6 in 10,000, except at the higher temperatures. This effect is to be ascribed to the expansion of the paraffin, the actual effect of absorption being of relatively small importance, except in those condensers of larger phase difference. In the latter case the temperature coefficient of the capacity is positive and increases rapidly with the temperature, reaching in some instances, values of the order of one per cent per degree.

2. In all cases, the capacity decreases with increasing frequency, at first rapidly and then more slowly, the changes being the larger, at all frequencies, in condensers with the larger phase differences.

3. While the phase difference of a mica condenser is usually less than 3′ or 4′ and often is as small as 30″ at 1000 cycles, the

[1] Bull. Bureau of Standards, 3: 371. 1907.

paper condensers here studied, in no case gave values less than 6′, and in the case of the poorer condensers the phase difference ranged from 1° to the enormous value of 22°. It was found that in the case of some telephone condensers, made by rolling up together long strips of tin foil and paraffined paper, the energy loss, in the resistance of the tin foil, amounted to considerably more than the loss in the dielectric. (This disadvantage may be avoided by making connection to the tin foil at several points along its length).

4. The phase difference generally increases with increasing temperatures; and in those condensers with large phase difference, the rate of increase becomes rapidly larger with rising temperature.

5. The phase difference, when corrected for the resistance of the plates and leads, decreases with increasing frequency, at first rapidly and then more slowly. The rate of change is greatest, at all frequencies, in the case of condensers with large phase difference.

6. The capacity of a paper condenser varies so considerably with the conditions under which it is used, that such a condenser should not be employed in work where a knowledge of the capacity is requisite, except where a previous study of the condenser has shown that it may so be used.

In the latter half of the paper, the absorption theories of Maxwell,[2] Houllevigue,[3] Pellat,[4] von Schweidler[5] and Hopkinson[6] are considered for a sinusoidal wave of electromotive force, and the formulas for the capacity and phase difference, as functions of the frequency, are compared with the observed results. The theory of von Schweidler (which is a modification of the Pellat theory and its mathematical equivalent, that of Hopkinson) assumes that the absorption in a dielectric is due to the presence of a periodically damped ions and the capacity and phase differ-

[2] Elect. and Magnet., I, § 330.
[3] Jour. de Phys., 6: 113. 1897.
[4] Ann. de Chim. et Phys. 18: 150. 1899.
[5] Ann. der Phys., 24: 787. 1907.
[6] Phil. Trans., 167: 599. 1877.

ence depend on the number and the distribution of these abnormal ions as a function of their rate of damping.

It is further shown that only a few constants need be determined in von Schweidler's equations to represent the observations with a good degree of accuracy. The remaining theories do not seem to be adequate to represent the present observations.

FISHERIES.—*Notes on the breeding season and young of Polyodon spathula.* WM. F. ALLEN, Institute of Anatomy of the University of Minnesota.

Since the appearance of Mr. Allis's recent papers in the Anatomischer Anzeiger on the "Pseudobranchial and carotid arteries of *Polyodon*" in which he made use of a specimen 130 mm. (5.5 inches) long, I have received several letters of inquiry as to when and where this material was obtained.

It is a well-known fact that nothing is known concerning the early development of *Polyodon*, and very few specimens under 6 inches in length have been obtained.

In 1904, when employed by Mr. Allis, I was sent to the Mississippi River for the purpose of obtaining all of the Ganoid material possible. After considering various localities on the Mississippi River system, the junction of the Ohio with the Mississippi, at Cairo, was selected as probably the most favorable place for obtaining this material.

For an entire year the bars of these rivers were seined at all times of the day and night; also the adjacent overflow lakes, sloughs, and small streams were seined at regular intervals thruout the year, and during the early spring a number of adults were obtained from hoop-nets placed in the channel on the Missouri side of the Mississippi, with the hope of obtaining sexually mature individuals whose eggs could be fertilized and the embryos reared.

So far as early embryonic material was concerned my results were a failure, but a great many specimens from 6 to 12 inches long were obtained, and about 25, varying in length from 4 to 6 inches were secured. Considerable data were obtained concerning the habits that may be of value in future search for this material.

Spawning Season.—In this locality the spawning of this species occurs during the month of March, mainly from the first to the middle of the month. I have never seen sexually mature *Polyodon* weighing less than 15 or 20 pounds and fish of this size are rarely, if ever, taken by seining the sand and mud bars of the rivers; they can, however, be obtained from the deep channel on the Missouri side of the Mississippi, from Bird Point south, by the use of hoop-nets. Floating ice prevented this mode of fishing for the first week of March, 1904, but during the second week, three mature females and several spent females were taken from these nets, but no males. One of these females was tied out from a fish wharf by a stout string attached to its tail, and the other two were placed in a fish cage anchored to the wharf, with the hope of keeping all three alive until a mature male could be secured, but with the result that the one tied out with a string was stolen and the two in the fish cage lived but four or five days, dying doubtless from injuries received in vain attempts to escape. Upon examining the eggs they appeared mature, were black in color, and very closely resembled the eggs of *Acipenser* and *Lepisosteus*. During the third week in March a single mature male was obtained along with several spent females. I am unable to account for the scarcity of males during the breeding season.

From this time on most vigorous efforts were made to secure the young of *Polyodon* by seining the small streams, sloughs, overflow lakes, and the sand and mud bars of the two rivers with a fine meshed seine, but not until July first were any located, when some 25 specimens of from 4 to 6 inches in length were caught from Minor Slough. This slough is located on the Kentucky side, at the junction of the Ohio with the Mississippi. It had been seined numerous times before this; in fact, the very day before, but always with negative results. The previous day (June 30) marked a high water stage of the rivers, and on July first the rivers were beginning to recede rapidly, so that there was a strong current in the outlet of the slough. The small *Polyodon* obtained doubtless migrated from the river during the previous night or early morning, when the water in the outlet could have

been almost at a standstill or a rather strong current. There is no ground whatever for believing that these little *Polyodon* were hatched and reared in Minor Slough.

While this seining was being done a violent thunder storm was in progress so that little time was spent in examination of these most interesting specimens; they were immediately thrown into a fixing fluid. It was noted, however, that their bill or paddle constituted about one-half of their total length, and that their bodies were almost transparent.

Notwithstanding that this slough and other overflow lakes and small tributary streams were afterward frequently seined with a fine-meshed seine, and the river bars were seined with both fine- and coarse-meshed seines, during both day and night, no other young *Polyodon* were found until late in August or early September, when a large number were obtained thru seining, at night or early morning, the mud and sand bars of the Ohio River opposite Cairo on the Kentucky side. Singular to say, they were never obtained in this manner during the day time. Apparently they never leave the channel except at night to feed in the mud and sand bars. These small fish were all obtained by the use of a very long coarse-meshed seine. It is possible that if a sufficiently long fine-meshed seine could have been operated on the river bars at night, or dragged on the bottom of the channel during the day, still younger stages would have been obtained.

My experience with *Polyodon* leads me to believe that it is primarily a deep-channel fish, that the eggs are laid and the young are reared in the deep channel rather than in the shallow water of the river, or in overflow lakes, or in small tributary streams; that the young do not leave the main channel to feed in the mud bars of the river or the sloughs until they have attained a length of 3 or 4 inches. About Cairo, Illinois the spawning season occurs during the month of March, and only specimens from 15 to 20 pounds and up are sexually mature. Fish of this size are rarely, if ever, taken in seining the river bars, but they can be had in small numbers from fishermen operating hoop-nets in the Missouri channel of the Mississippi south of Bird's Point.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

ELECTRICITY.—*Outline of design of deflection potentiometers, with notes on the design of moving-coil galvanometers.* H. B. BROOKS. Bulletin Bureau of Standards **8**: No. 2. 1911.

This paper outlines the principles on which deflection potentiometers are designed, and gives a numerical example. It includes some notes on the fundamental constants of the moving-coil galvanometer, and shows how to change the field strength, spring strength and size of wire in order to secure a desired galvanometer performance. A procedure is outlined which is intended to facilitate the production in quantity of galvanometers whose resultant performance is satisfactory, while allowing some latitude in the values of individual constants. H. B. B.

ELECTRICITY.—*Deflection potentiometers for current and voltage measurements.* H. B. BROOKS. Bulletin Bureau of Standards, **8**: No. 2. 1911.

The deflection potentiometer differs from the usual potentiometers in one essential feature, viz., the use which it makes of the galvanometer. The greater portion of the electromotive force under observation is compensated, but the galvanometer deflection indicates the remainder. The accuracy obtainable by the potentiometer method is thus combined with the ease and speed of reading a deflection. In previous papers (Bulletin of Bureau of Standards, **2**: 225. 1906, and **4**: 275 1908) the writer has described two forms of deflection potentiometer, both intended for voltage measurements only. This paper describes two new instruments, each of which is suitable for both current and voltage measurements. The theory of the deflection potentiometer used with current shunts is developed, and a special set of values for such shunts is shown to give economy of time in testing, with reduced computation and liability of error. J. H. DELLINGER.

PHYSICS.—*High-temperature gas thermometry.* ARTHUR L. DAY and ROBERT B. SOSMAN; with an investigation of the metals by E. T. ALLEN, Geophysical Laboratory. Publication No. 157, Carnegie Institution of Washington.

The errors which have heretofore been present in measurements with the nitrogen thermometer have been reduced by the present investigation to about one-fourth their former magnitude, and the certainty of their evaluation is at least proportionately increased.

The particular points to which most attention has been given are the following:

(1) To provide a uniform temperature about the bulb by a suitable arrangement of electric-heating coils and diaphragms.

(2) To enclose the furnace in a gas-tight bomb in which the pressure outside the bulb can be maintained equal to that within for all temperatures. This offers three distinct advantages: (*a*) it provides against the deformation of the bulb through differences of pressure within and without in the region of highest temperatures, where the bulb material becomes softer; (*b*) by using the same gas within and without, there is no tendency for it to diffuse through the bulb wall; (*c*) it enables the initial pressure to be varied within considerable limits, thereby increasing both the scope and sensitiveness of the manometer.

(3) The expansion of the bulb material was determined with great care and is probably accurate within 0.5 per cent.

(4) The unheated space between the bulb and manometer has been reduced until the total correction in this hitherto uncertain region amounts to less than 4° at 1100°. An error of 5 per cent in the determination of its volume or temperature distribution is, therefore, practically negligible.

It is probable that these changes serve to reduce the uncertainty hitherto prevailing in the correction factors which require to be applied to the gas thermometer in the region of 1100° to less than one-tenth of its former magnitude. Furthermore, these improvements are equally applicable throughout the region above 1100° as far as the present measurements have extended (to 1550°). The chief source of the present uncertainty is the temperature distribution over the surface of the bulb in an air-bath.

No effort has been made to prepare metals of exceptional purity in our own laboratory, for the reason that such metals would not be available for general use and would therefore be of little service. We have accordingly adopted metals which are carried permanently in stock by dealers.

In order to facilitate as far as possible the application of these results

in general practice, a typical thermo-element curve has been tabulated in small 10° intervals thruout its entire length from melting ice to melting platinum, together with a diagram showing the character and magnitude of the variation from this curve which may be expected to appear in other thermo-elements of the same nominal composition (90 parts platinum, 10 parts rhodium). With a new platin rhodium thermo-element of undoubted homogeneity, but unknown constants, it is quite practicable with this table to prepare a curve of its electromotive force for any temperature with sufficient accuracy for most purposes (say 5° at low temperatures and ± 10° above 1200°) from a single determination in melting copper.

LIST OF STANDARD MELTING POINTS

SUBSTANCE	POINT	ATMOSPHERE	CRUCIBLE	TEMPERATURE	REICHSANSTALT SCALE
				°	°
Zinc.....	Melting and freezing	Air	Graphite	418.2±0.3	419.0
Antimony.	Melting and freezing	Carbon monoxide	Graphite	629.2±0.5	630 .
Silver....	Melting and freezing	Carbon monoxide	Graphite	960.0±0.7	961.5
Gold.....	Melting and freezing	Carbon monoxide	Graphite	1062.4±0.8	1064.0
Copper....	Melting and freezing	Carbon monoxide	Graphite	1082.6±0.8	1084.1
Diopside (pure)	Melting	Air	Platinum	1391.3±1.5	
Nickel	Melting and freezing	Hydrogen and nitrogen	Magnesia and magnesium aluminate	1452.3±2.0	
Cobalt....	Melting and freezing	Hydrogen and nitrogen	Magnesia	1489.8±2.0	1575 1
Palladium	Melting and freezing	Air	Pure magnesia	1549.2±2.0	
Anorthite	Melting	Air	Platinum	1549.5±2.0	

There is no sure way to guard against the contaminating influence of metal-vapors upon a thermo-element in laboratory or industrial practice, altho glazed porcelain is usually effective. There are very simple and rapid means of detecting contamination in an element and determining its distribution, and with a second element at hand for an occasional comparison there is little of serious danger from this cause. In any case, the slight inconvenience is well worth while wherever considerable accuracy is sought, for there is no other device yet available, in the region between 1100° and 1600°, which is comparable with the thermo-element in sensitiveness and general practicability.

In conclusion, the list of standard melting-points is given in tabular form, together with an estimate of the degree of trustworthiness to be accorded to each. Beside it for convenient comparison is the present Reichsanstalt scale. It may be added that no indication of a limit to the temperature attainable with the nitrogen thermometer or to its ultimate accuracy was discovered during the present investigation.

In addition the following temperatures were incidentally obtained:

SUBSTANCE	POINT	ATMOSPHERE	CRUCIBLE	TEMPERATURE	REICHSANSTALT SCALE
				°	°
Cadmium..	Melting and freezing	Air	Graphite	320.0±0.3	321.7
Aluminum	Freezing	Carbon monoxide	Graphite	658.0±0.6	657
Li_2SiO_3....	Melting	Air	Platinum	1201 ±1	
Platinum .	Melting	Air		1752	
				1755 ±5	

A. L. D and R. B. S.

ECONOMIC GEOLOGY.—*The production of asbestos in 1910.* J. S. DILLER. Advance chapter from Mineral Resources of the United States for 1910, pp. 1–13. *The types, modes of occurrence and important deposits of asbestos in the United States.* J. S. DILLER. U. S. Geological Survey Bull., 470-K, pp. 3–22, with 2 maps. 1911.

The annual production of asbestos for 1910 in the United States was 3,693 tons, about one-twentieth as much as that of Canada whose output for the same time was 75,578 tons, which is 78 per cent of the total production of all countries. Georgia and Vermont are the chief producers

in the United States, but Arizona, Idaho, Virginia and Wyoming have deposits of special interest.

The fundamental property of asbestos is its fibrous structure, and it includes the fibrous forms of several species of minerals, especially amphibole and serpentine.

Using the term "type of asbestos" to designate the form of fibrous aggregation and "mode of occurrence" to designate the environment of the asbestos deposit, referring especially to its relation to the rocks with which it is genetically associated, there are three types of asbestos and four modes of occurrence known in the United States.

The three types of asbestos are cross fiber, slip fiber, and mass fiber. The first occurs in veins and the fibers, if not disturbed since their formation, run across the veins. The second occurs along planes of rock fractures on which slipping has occurred, and the direction of the parallel fibers in the slipping plane indicates the direction of the slipping. The third occurs in the form of bundles or groups and the fibers may be parallel or divergent. It is strongly contrasted with cross fiber and slip fiber in that it forms the whole mass of the rock in which it is developed.

Asbestos of the cross fiber type is almost invariably chrysotile (serpentine) and rarely anthophyllite. Some of the slip fiber type is chrysotile but more is amphibole. The mass fiber type, so far as known, is always anthophyllite in the United States.

The first mode of occurrence is illustrated by the mines at Chrysotile, in the Lowell region of Vermont, where the productive serpentine belt, so extensively mined in eastern Canada, reaches the United States. There is a similar but less productive locality near Casper, Wyoming.

An excellent illustration of the second mode of occurrence is in the Grand Canyon of the Colorado in Arizona, where veins of high-grade cross fiber chrysotile occur in a narrow belt of limestone. The limited quantity and difficult accessibility hinders mining in that region.

The third mode of occurrence as mass fiber (anthophyllite) is well illustrated at Sall Mountain, Georgia, where though much less valuable than chrysotile it has been mined for many years. There is a similar deposit at Kamiah, Idaho.

The fourth is illustrated by the slip fiber veins in the hornblendic and pyroxenic rocks of Bedford City and Rocky Mount, Va., where unsuccessful attempts to mine it were made some years ago. J. S. D.

HYDRAULICS.—*Measurements of the suction of vessels made in the experimental model basin at the Navy Yard, Washington, D. C.* U. S. Hydrographic Office Pilot Chart of the North Atlantic Ocean for June, 1911.

Naval Constructor D. W. Taylor has recently investigated the question of the relative reactions of vessels under way and close to one another. These reactions are found to be strong, and the suction due to them when vessels make ill-advised attempts to pass others too closely account for many collisions especially in shallow waters.

The models, which were of a mean immersed length of 20 feet and of a displacement of 3000 pounds, were towed in pairs abreast, or at definite distances ahead or astern. In the abreast positions, they were towed at various distances apart; for other positions, the uniform distance apart of their center lines was nineteenth-hundredths of the length of the model. While this is quite close, it should be remembered that these experiments were made in water many times deeper than the draught of the models, and hence the suction effects under given conditions would be less than if the water had been relatively shallow, as is usually the case when suction phenomena are of importance in connection with actual ships. Imagine one vessel overtaking another on a parallel line, quite close to the right of the latter, then the sequence of phenomena is about as follows:

When the overtaking vesse. just begins to overlap the other, there is little force acting. There appears to be a repulsion at both bow and stern, and curiously enough the repelling force upon the stern appears to be greater than that upon the bow. The resulting tendency is for the overtaking vessel to turn in toward the overtaken vessel. When partially overlapping, the tendency is for the bow to be drawn in while the stern is still repelled.

As the overtaking vessel continues to pull up, the suction at the bow becomes stronger and the repulsion of the stern falls off, until, as they come abreast, there is a rapid change in the stern force, which shifts from repulsion to strong suction.

As the overtaking vessel draws ahead, there is a reversal of conditions, the bow pull falling off rapidly, and soon becoming a repulsion, while the stern pull becomes stronger, reaching its maximum when the center of the overtaking vessel is about two-tenths its length ahead the center of the overtaken vessel. It should be understood that the idea of the right hand vessel overtaking the other is simply used for convenience in description. For given relative positions, the forces upon the right-hand vessel would be the same whether overtaking or overtaken.

In close quarters the intensity of these reactions may amount to twice the resistance of the vessel to propulsion, and situations may readily arise in which vessels will be brought into collision regardless of the action of the rudder. G. W. LITTLEHALES.

FISHERIES.—*Special investigation of the Alaska fur-seal rookeries, 1910.* HAROLD HEATH. Bureau of Fisheries Document No. 748. Pp. 22. November, 1911.

Dr. Heath, sent to the Pribilof Islands as a special scientific investigator pending the permanent appointment of a resident naturalist under the act of Congress of April 21, 1910, affecting the seal fisheries, reports that compared with estimates of the preceding year the herd has apparently undergone a loss of 13,293 in its numbers, by reason of the incessant killing of seals at sea in the vicinity of the islands by the Japanese and Canadian fleets.

The breeding herd is well supplied with male life, however, the average harem in 1910 containing fewer than 32 cows and there being a surplus of 600 idle and young bulls. With such proportions of the sexes and the polygamous habit of the seal, and with, moreover, a breeding reserve of 1,000 to 2,000 bachelors exempted from killing every year, there is no possibility of injury to the seal herd as a result of land killing under present regulations. ETHEL M. SMITH.

FISHERIES.—*The salmon fisheries of the Pacific coast.* JOHN N. COBB. Bureau of Fisheries Document No. 751. Pp. 179. November, 1911.

This report is historical, descriptive and statistical, covering the entire period of salmon canning on the west coast, discussing the development of fishing methods and preservation processes, and containing figures for every year from the beginning of the industry down thru 1909. It contains also a chapter on fishery legislation and law enforcement, an account of salmon hatchery work, and figures showing the foreign trade in salmon. E. M. SMITH.

FISHERIES.—*The fur-seal fisheries of Alaska in 1910.* WALTER I. LEMBKEY. Bureau of Fisheries Document No. 749. Pp. 35. November, 1911.

The status of the fur-seal industry of Alaska was changed by the law of April 21, 1910, the former leasing system being abandoned for direct government management of these resources.

The law relating to the killing of seals on the Pribilof Islands exempts all females and all seals under one year of age. The additional Depart-

ment regulations, similar in 1910 to the regulations of previous years, restricted the killing further to bachelors having pelts weighing at least 5 pounds and not more than 8½ pounds, except such as might be required to complete the natives' supply of food. Before any killing was done 1,271 bachelors, 915 of them three-year-olds, were marked and exempted as a breeding reserve. The take of skins was 13,584.

Mr. Lembkey's estimate of the number of seals in the herd in 1910 at the end of the killing season is 132,279. This is approximately the same as Dr. Heath's estimate of 149,195, the latter figure including the 13,584 that were killed.

Mr. Lembkey urges the continued killing of surplus male seals, not only to permit the government an income from the seal resources but to preserve the herd from the injurious presence of the haremless and fighting bulls. He urges also a readjustment of the scheme of compensation for the natives, abolishing the government contribution as such and paying higher wages. E. M. SMITH.

PLANT PATHOLOGY.—*The timber rot caused by Lenizites sepiaria.* PERLEY SPAULDING, Bureau of Plant Industry, Bulletin 214, Pp. 46. July 21, 1911.

Lenzites sepiaria is one of the most important of the fungi which destroy coniferous timber while in use. It does not ordinarily attack living trees. With several other species it destroys a large proportion of the coniferous railway ties and telegraph and telephone poles which are in service in this country. The fungus is very widely distributed and attacks the wood of spruce, larch, fir, pine, hemlock, Douglas fir, and juniper, and occasionally attacks the wood of willow and aspen. It usually enters timbers through season cracks. The fruiting bodies revive after long periods of desiccation, the writer having obtained spores from specimens after two years' time. Mature sporophores may be produced within six or ten days after the first mycelium becomes visible on the exterior of an affected timber. Inoculations in green timber have produced sporophores within five months'time in Texas. Pure cultures have been made and the same type of rot has been secured upon sertilized wood blocks in large tubes as that which commonly accompanies the fruiting bodies in the open air. The decay caused by this fungus may be prevented or greatly retarded by seasoning of timber, which decreases the water content to such a point that the fungus cannot readily grow; by floating, which largely excludes the air; and by chemical treatment with substances which are poisonous to the fungus. P. S.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 486th regular meeting was held at the Cosmos Club, October 21, 1911, President David White in the chair, and about 60 persons present.

The principal communication was presented by O. P. HAY, of the U. S. National Museum on *The Ice Age and its Animals*, illustrated by lantern slides, showing maps of the areas of successive glaciation and photographs of the characteristic fossils as well as restorations of the mammals.

The 487th regular meeting was held November 4, 1911, the president in the chair and about 75 persons present.

Under the heading *Brief Notes and Exhibition of Specimens*, W. P. HAY exhibited lantern slides from photographs of living *Amphioxus*, and of the blue crab, with egg masses. He calculated the number of eggs laid by the female of this species as about 1,500,000.

The regular communication was on *Recent Biological Explorations in Panama*, participated in by S. E. MEEK, E. A. SCHWARTZ, E. A. GOLDMAN, and AUGUST BUSCK.

In the fall of 1910 the Smithsonian Institution perfected plans for a somewhat comprehensive and thoro biological survey of the Panama Canal Zone. It was realized that the solution of a number of vital problems in the geographic distribution and origin of the fauna and the flora of that region requires thoro field investigations in the Zone and adjacent territory before the great physiographic changes occur which will come with the completion of the Canal. It was therefore felt that the necessary field work should be undertaken at once. With this object in view Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, invited the various scientific bureaus of the government to coöperate with the Institution in making such a survey. The Bureau of Fisheries and the Field Museum of Natural History, having already contemplated making such a study of the aquatic life of the Zone, promptly joined the Smithsonian, and the entire work was carried on under the general direction of that Institution.

The Bureaus and institutions participating in the survey are as follows: The Smithsonian Institution; the Field Museum of Natural History; the Bureau of Fisheries; the Biological Survey; the Bureau of Plant Industry, and the Bureau of Entomology.

At this meeting Dr. E. A. Schwartz and Mr. August Busck of the Bureau of Entomology told of the entomological work done by the recent

expedition to the Canal Zone. The work of former collectors of insects in the region was reviewed as well as that done during the present year. The climatic conditions were described and their effect on the insect fauna was considered. The operations incident to digging the Canal have destroyed much of this fauna in the immediate vicinity of the work. In spite of efforts to destroy them, a few flies and mosquitoes still exist.

Dr. S. E. Meek of the Field Museum spoke of the fishes and other aquatic life of the Canal Zone and showed maps and a series of pictures of characteristic scenery along the streams in which collecting was done, as well as of operations along the Canal route. In Dr. Meek's field work he was assisted by Mr. S. F. Hildebrand of the Bureau of Fisheries. They landed at Cristobal, December 28, and at once entered upon their field investigations which they continued without interruption until the twenty-fourth of the following May. They gave first attention to those streams soon to be most changed by the work on the Canal. Then collecting was done in the brackish waters and along the shores in order that ample series of specimens might be gotten of those species most likely to pass through the Canal on its completion. Practically all the streams of the Zone and a few adjacent ones on the Pacific side were thoroly explored. Much additional work remains to be done in the salt and brackish waters, particularly on the Atlantic side, and in the streams in the adjacent territory.

It is necessary to extend the explorations to the streams and shallow bays on each side of the Zone for a distance of 50 to 100 miles. It is the intention to do this during the coming winter.

Mr. E. A. Goldman of the Biological Survey told of his field work in studying the distribution and abundance of the mammals and birds, and collecting specimens. He remained in the field from December 28 to the end of June following. Gatun was selected as headquarters, as that region will undergo great biologic changes as a result of the transformation of a forest into a lake with an area of 164 square miles upon the completion of the Canal. Nearly 2500 specimens were secured. Among bird groups the antthrushes, flycatchers, woodhewers and hummers are most numerous in genera and species. Mammals of 39 genera, exclusive of bats, were collected. These included five genera of monkeys and four generations of opossums. One of the most interesting of the mammals collected is a specimen of *Bassariscyon*, one of the rarest of American mammals in the museums of the world. The genus has a known range extending from Nicaragua on the north to Ecuador on the south, and while it includes four species probably less than 10 individuals, all told, have been collected.

While the work was concentrated largely in the Gatun Lake area collections were also made at various localities along the line of the Panama Railroad southward to the Pacific coast, and in adjoining parts of Panama. In March a trip was made overland from Chepo into the mountains near the headwaters of the Chagres River where ten days were spent on the Cerro Azul, a mountain about 3000 feet high. To reach this mountain pack horses were used to transport the field outfit

across the broad, open savannas which extend from the Pacific coast to the base of the mountain, where the loads were transferred to the backs of men. At this point the heavy forest begins abruptly and extends upward in unbroken growth, becoming lower, but denser, until on the summit where the rainfall is more copious, orchids and bromeliaceous plants overspread the ground as well as the branches of the trees. In the latter part of May work was carried on at Porto Bello, on the north coast, and by traversing swamps and wading eight or ten miles up the Cascajal River the upper slopes of the Cerro Brujo were reached at about 2000 feet altitude. D. E. LANTZ, *Recording Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 245th meeting was held at the Cosmos Club, May 10, 1911. As an informal communication Mr. L. D. BURLING exhibited specimens of Silurian crinoid stems associated with Pleistocene mollusks collected on the beach north of Chicago. Both are well preserved and afford an example of mechanical mixture of faunas of widely different age.

REGULAR PROGRAM

The anorthite-nephelite series. N. L. BOWEN.
The classification of higher grade coals. G. C. MARTIN.
On the classification of ore deposits. WALDEMAR LINDGREN.

At the 246th meeting, May 24, Mr. E. W. SHAW presented two new facts concerning the Maquoketa formation of the Upper Mississippi lead and zinc district: (1) Certain more or less round bits of rock resembling concretions with obscure structure and found in a layer near the base of the formation are fossil algal secretions. (2) There is a heretofore undescribed angular unconformity between the Ordovician and Silurian at the top of the Maquoketa shale, and a non-fossiliferous rock which has been considered to be Maquoketa is in reality Silurian resting upon the thin parts of the Maquoketa. The Marquoketa, instead of being 200 feet thick as stated in published reports, varies from 180 to less than 100 feet. At the base of the non-fossiliferous rock and resting upon the deeply eroded Maquoketa is a thin layer appearing to be laminated sandstone but made up of grains of dolomite.

By invitation of the Council Prof. JOHN C. MERRIAM of the University of California spoke on recent progress in the correlation of the Tertiary lacustrine deposits of the Pacific coast and Great Basin regions.

REGULAR PROGRAM

Phosphate deposits of the United States. F. B. VAN HORN.

There are at present five producing phosphate fields of the United States. In the order of quantity of production they are:

(1) Florida, (2) Tennessee, (3) South Carolina, (4) Arkansas, (5) The Western States—Idaho, Wyoming, and Utah.

In quantity available for the future the most important of these fields is the last named one, where enormous deposits of high grade phosphate rock are available for mining. Tennessee ranks second; Florida third; South Carolina fourth; and Arkansas last.

The Florida deposits are of three classes: hard rock, land pebble, and river pebble, of which the land pebble is of most importance. The Tennessee deposits are also of three classes, according to Hayes; brown residual phosphate, blue bedded phosphate, and white phosphate. The South Carolina phosphate occurs in two forms: hard rock, and river rock. The phosphate of Arkansas occurs in bedded form.

The deposits of the Western States are in northeastern Utah, southwestern Wyoming, and southeastern Idaho. The phosphate horizon consists of 200 feet of phosphatic shales and beds of phosphate rock with some limestone. The rock phosphate itself is chiefly characterized by an oölitic texture, by which it can usually be recognized in the field. In color it varies from coaly black to dull gray or iron stained. Its float is characteristically marked with a thin coating of bluish-white bone-like material, resembling chalcedony, and this coating is useful in tracing the concealed outcrop in the field by means of scattered float or fragments to be found in the overlying soil.

Asbestos deposits of the United States. J. S. DILLER. See this Journal, 1: 286. 1911.

Further data on the stratigraphic position of the Lance formation ("Ceratops beds"). F. H. KNOWLTON.

In June 1909 the author published a paper entitled, "The stratigraphic relations and paleontology of the 'Hell Creek beds,' 'Ceratops beds,' and equivalents, and their reference to the Fort Union formation," in which the conclusion is reached that the beds considered are "stratigraphically, structurally, and paleontologically inseparable from the Fort Union, and are Eocene in age." The present paper presents the results of the two field seasons that have intervened since the first paper was published, the areas in which the observations were made being in the main eastern Wyoming and eastern Montana and adjacent portions of North and South Dakota.

In the early nineties Hatcher discovered dinosaurian remains along the North Platte River some 25 or 30 miles north of old Fort Fred Steele, in Carbon County, Wyoming, the exact locality being indicated as "opposite the mouth of the Medicine Bow River." This area was investigated in 1906 by A. C. Veatch, who published an outline geological map in which was shown the areal distribution of the formations involved. Strictly interpreted Hatcher's locality would fall within Veatch's so-called "Lower Laramie," which is there 6500 feet in thickness, and is separated from the overlying beds (Upper Laramie of Veatch) by an unconformity which according to Veatch has involved the removal of more than 20,000 feet of strata, but as a matter of fact his locality is a mile or more up the North Platte from a point "opposite

the mouth of the Medicine Bow." The author, assisted by Dr. A. C. Peale, visited the area in 1910 and failed to find a trace of remains of dinosaurs in the "Lower Laramie," but did find Triceratops in place 300 feet above the base of the "Upper Laramie," or Lance formation as it must now be called. This discovery is regarded as of far-reaching importance, since it proves that the Lance formation ("Ceratops beds"), which elsewhere rests on Fox Hills and other Montana formations, is here above a great unconformity which separates it from the 6500 feet of "Laramie" and effectually disposes of the contention that the Lance formation is the equivalent of the Laramie.

An area in South Dakota west of the Missouri River and between the Cannonball and Cheyenne Rivers, was studied in 1909 by parties from the U. S. Geological Survey under the general charge of W. R. Calvert, who furnished the data for this part of the paper. The four formations present in this region are Pierre, Fox Hills, Lance and Fort Union. The Fox Hills with a maximum thickness of 150 to 200 feet, has been irregularly reduced by erosion and in exceptional instances has been entirely removed. The Lance formation rests on the eroded surface of the Fox Hills and in at least one locality upon the Pierre. Angular as well as erosional discordance has also been noted between them, especially on the Moreau River near Govert P. O., where the Fox Hills dips at an angle of 10° and the overlying Lance is horizontal. The marine Fox Hills invertebrates, reported at five localities in the basal 10 or 12 feet of the Lance formation, are presumed to be re-deposited, as they always occur in eroded channels.

Converse County, Wyoming, the type locality for the Lance formation, has been visited by several parties and the attempt made to fix the upper line of the Fox Hills, but while it appears that these beds are of unequal thickness, the fact remains that the upper limit is not yet definitely placed.

In southeastern Montana the relations between the Fox Hills and the overlying Lance formation were found to be the same as already shown for South Dakota, that is, they are separated by an unconformity which is erosional and occasionally also angular.

In the original paper the statement was made that thruout the vast region studied the Lance formation was found conformably overlain by the acknowledged Fort Union. Field work of the past two seasons has confirmed this in every particular, and there is yet to be observed a single locality at which unconformable relations have been even suspected. Hence it seems to have been demonstrated that sedimentation from one to the other was continuous and uninterrupted.

The following conclusions regarding the stratigraphic relations of the Lance formation seem justified: (1) The Lance formation is separated from the underlying formations by an unconformity, which in some cases at least is profound; (2) the Lance formation is not the equivalent of the Laramie, in fact, as shown by the relations in Carbon County, Wyoming, they are separated by a great unconformity; (3) the Lance formation cannot be separated on structural or lithologic grounds from

the overlying Fort Union; (4) the line at the base of the Lance formation becomes more clearly than ever the logical point at which to draw the line between Cretaceous and Tertiary; (5) finally, the Lance formation seems to find a final resting place in the Tertiary.

EDSON S. BASTIN,
ROBERT ANDERSON,
Secretaries.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

At the 697th meeting, held at the Cosmos Club on October 14, 1911, the following papers were read: *Direct and indirect determination of the wilting coefficient of soils for different plants:* L. J. BRIGGS and H. L. SHANTZ. (See this Journal 1: 228. 1911.) *Magnetic rotation and ellipticity for massive mirrors:* P. D. FOOTE. (See this Journal 1: 145. 1911.)

The 698th meeting, held on October 28, 1911, at the Cosmos Club, was a joint meeting with the Washington Academy of Sciences. Professor ARTHUR SCHUSTER, by invitation, presented a most interesting and instructive paper on *The foundations of physics.*

At the 699th meeting, November 11, 1911, at the Cosmos Club, the following papers were presented, A. J. LOTKA: *Evolution in discontinuous systems;* P. G. NUTTING: *Helium tubes as light standards.* (See this Journal 1: 221. 1911.)

R. L. FARIS, *Secretary.*

THE COLUMBIA HISTORICAL SOCIETY

At the 125th meeting, November 21, 1911, Mrs. CORRA BACON-FOSTER presented a paper on the *Early Development of the Potomac Route to the West.*

MARY STEVENS BEALL, *Secretary.*

CORRECTIONS, VOL. 1

p. 55, Fig. 1, for "1537° C." read "1357° C."
p. 213, lines 3 and 9, for "(*c*)" read "(*e*)."
p. 213, line 15 from bottom, for "one" read "the."
p. 214, line 15, after "force" insert "for unit current in each circle."
p. 216, line 7, before "current," for "the" read "this."
p. 217, line 16, after "called," for "the" read "this."
p. 217, table, for "22° C." read "20° C."
p. 218, line 3, for "*N*" read "*M*."

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